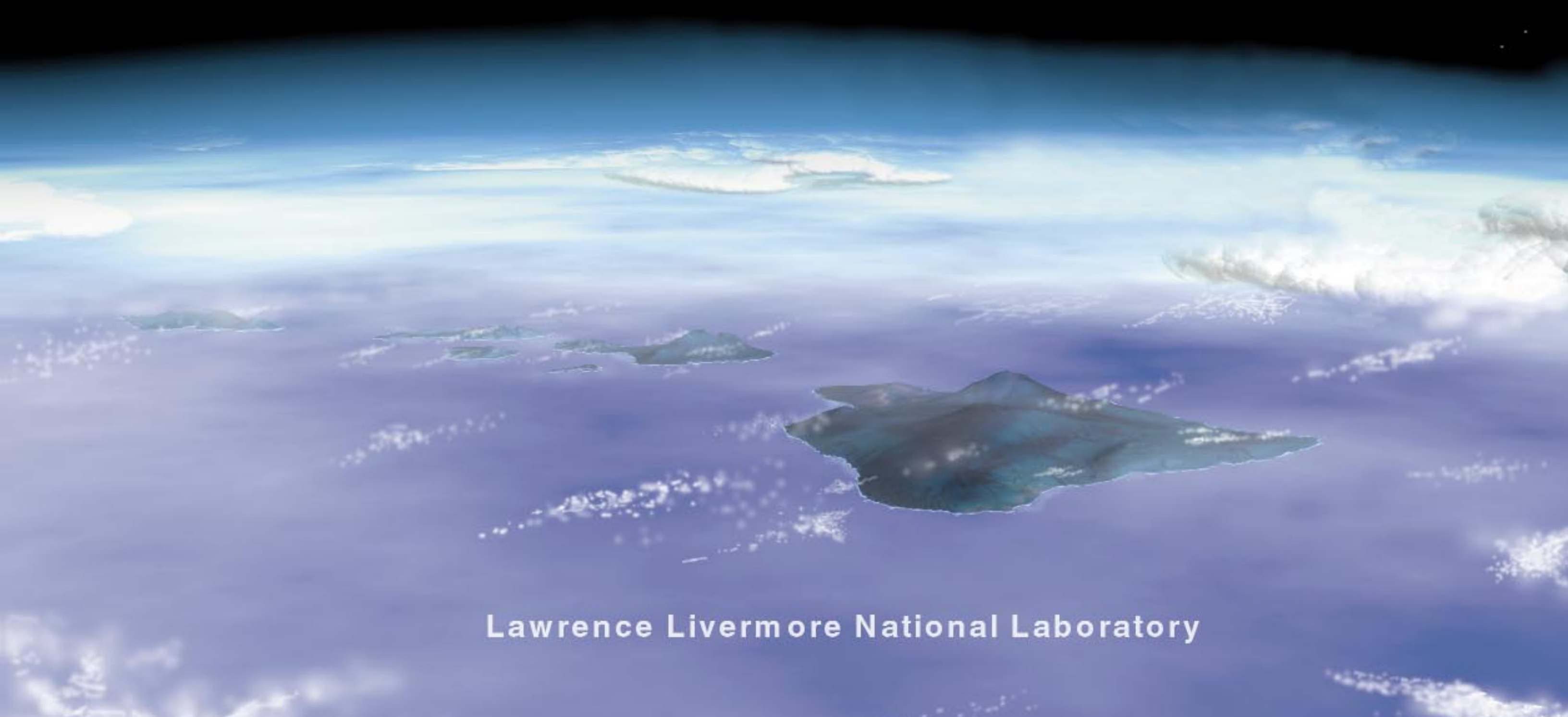
ENGINEERING X

Pushing engineering science to the Xtreme



Lawrence Livermore National Laboratory

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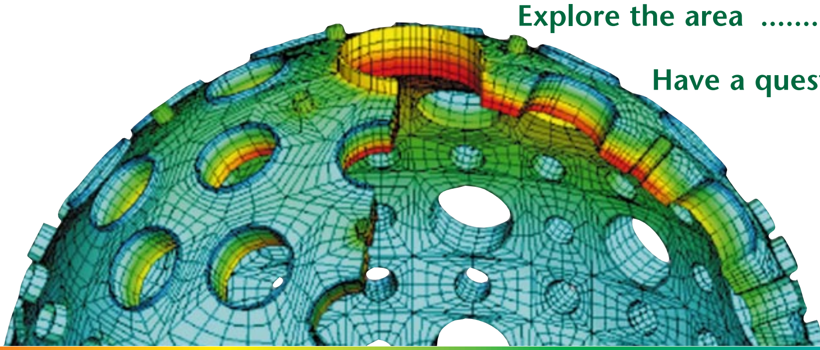


ultrascale

Writers/Editors
Ann Parker
Carol Gerich

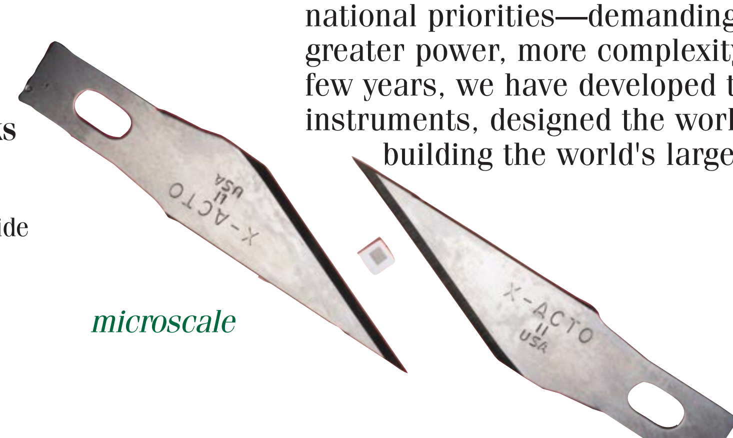
Designer
Pamela Allen

Graphic Artists
Jeffrey Bonivert
Dennis Chan
Judy Rice
Kelly Spruiell

Special Thanks
Michael Anthony
Marcia Johnson
Jacqueline McBride
Jim McInnis

Engineering at Lawrence Livermore National Laboratory has always been known for doing the impossible: creating new technologies to solve critical national problems. Today Engineering is pioneering technologies that extend the range of solutions from microscale to ultrascale, often simultaneously. We call our breakthroughs at these poles **"Xtreme Engineering."**

Engineers work with others at the Laboratory, the Department of Energy, the University of California, and private industry to address national priorities—demanding even smaller parts, faster times, greater power, more complexity, and higher precision. In the last few years, we have developed the world's smallest biomedical instruments, designed the world's fastest aircraft, and are now building the world's largest laser.

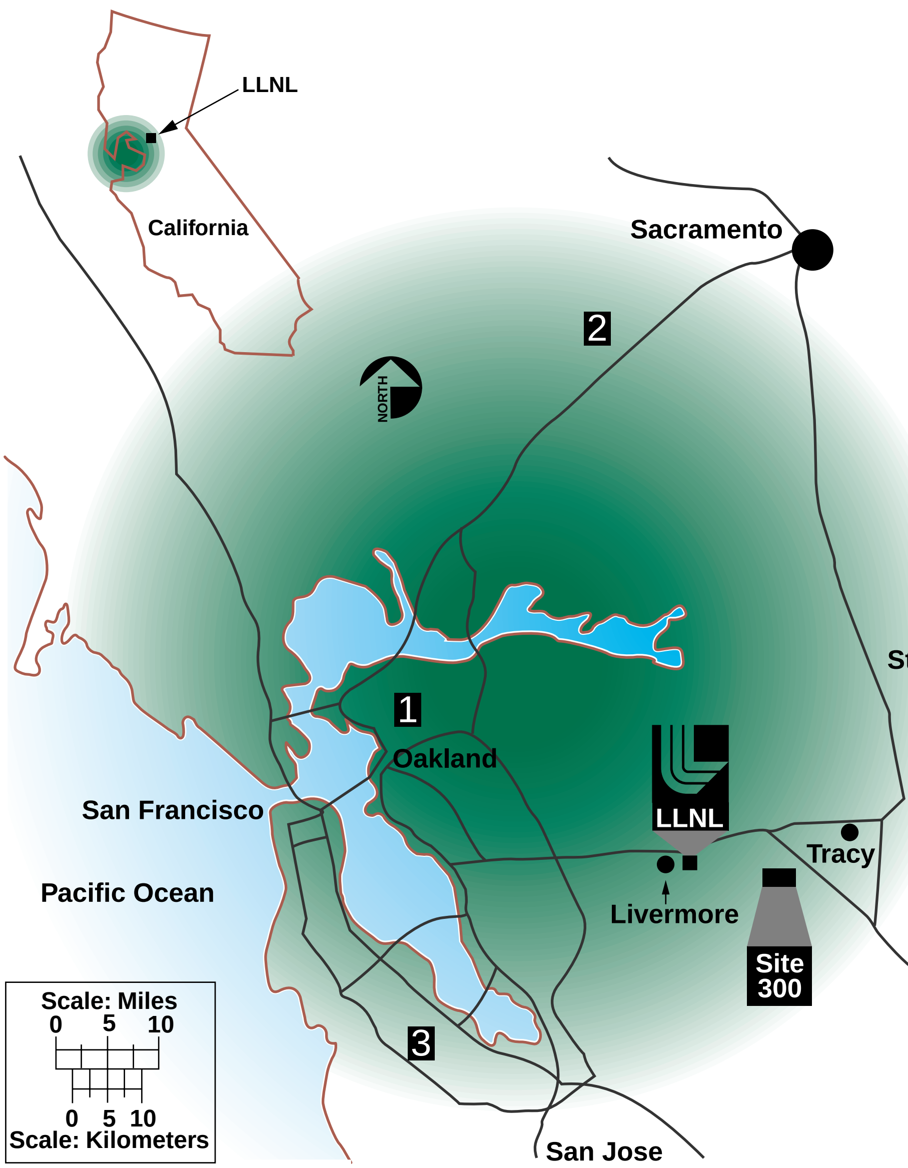


microscale

WHAT ARE YOU LOOKING FOR AS YOU CONTINUE YOUR ENGINEERING CAREER?

- A high-tech organization that pushes technologies to extreme dimension?
- A worksite that is comfortable and collegial, where business dress is unusual, and noontime athletic activities abound?
- A community that is within easy reach of the ocean, the mountains, and the desert—the most scenic parts of the U.S.?
- All of the above?

Lawrence Livermore National Laboratory offers high-tech engineering in a comfortable atmosphere where you can pursue exciting work and first-class recreation. Here at LLNL you can create your own future at a place that demands excellence and allows you to jump quickly into the driver's seat of your career. At the Laboratory, you will gain exceptional experience working on issues of national and international importance, while developing technologies that can propel new businesses and improve everyday life.



Lawrence Livermore National Laboratory (LLNL) is located within the boundaries of the greater San Francisco Bay Area, close to many major institutions of higher learning. The Laboratory also has a remote test site, "Site 300," located in the nearby Altamont Hills.

1 University of California, Berkeley
2 University of California, Davis
3 Stanford University

WHY CHOOSE TO BE AN ENGINEER AT LAWRENCE LIVERMORE?

Are you looking for a place where you work on some of the nation's most challenging scientific problems? A place where you can use the most current systems and cutting-edge technologies? A place where you will help pioneer Xtreme Engineering? If so, consider a career in engineering at Lawrence Livermore National Laboratory (LLNL).

Lawrence Livermore is a national security laboratory and one of the top centers for science and engineering research in the world. The Laboratory's multiprogram, multidisciplinary approach enables it to meet evolving national needs, whatever they may be.

When it was founded in 1952, Livermore had 75 people; today, it has a staff of 7000 employees. The University of California, which helped establish the Laboratory, still manages its operations for the Department of Energy. All Laboratory employees are employees of the University.

LLNL prides itself on its heritage of technical excellence. This heritage rests first and foremost with its people. From the Lab's very beginnings, engineers have been key in establishing and maintaining the Lab's world-wide reputation for multidisciplinary research and development (R&D). From lasers and electro-optics research to the human genome project, LLNL engineers make unique contributions to a diverse range of nationally important issues.

As an engineer at the Laboratory, you will have challenging assignments and be involved in projects from inception to completion. You will find opportunities to enhance and build upon your skills, opportunities to advance your career, and access to exceptional facilities and systems. As one engineer put it, "The only limits are the ones you set within yourself."

Whether you are a recent college graduate or an experienced engineer, if you are looking for a challenge, consider joining the Laboratory. In the following pages, you'll find out more about Engineering—its people, technologies, and facilities—and about the Laboratory and its programs. You'll also discover some of the benefits of working at the Lab. So, read more about us, and see if LLNL's Engineering is the place for you!

"The only limits are the ones you set within yourself."

MEET ENGINEERING—WE COMBINE THE BEST PEOPLE, TECHNOLOGIES, AND FACILITIES

In Engineering, our mission is to make Livermore's programs succeed and grow. We do this through developing cutting-edge technologies, talented people and state-of-the-art facilities. You, too, can be a part of this dynamic combination.

Cutting-edge technologies

The Engineering organization invests heavily in a portfolio of forward-looking technologies that feature Xtreme Engineering advances, pushing the forefront of scientific R&D. No matter what their specialties, our engineers have access to the entire portfolio to help them get the job done. As engineers move from program to program and apply these technologies to different problems, the capabilities of these technologies expand, and our engineers build their own incredible toolbox of skills.

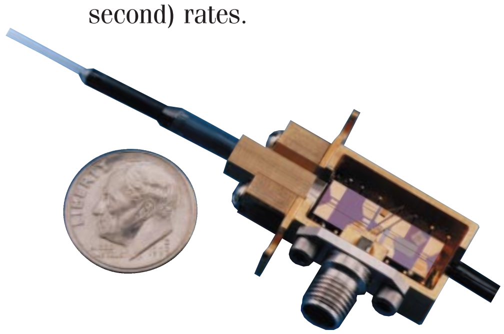
Engineering conducts innovative research and development in technologies such as:

- Electromagnetic and applied mechanics modeling
- Microtechnology
- Laser engineering and electro-optics
- Precision engineering
- Remote sensing and diagnostics
- Image processing and nondestructive evaluation
- Systems assessment, risk and reliability analysis
- Materials testing and modeling.

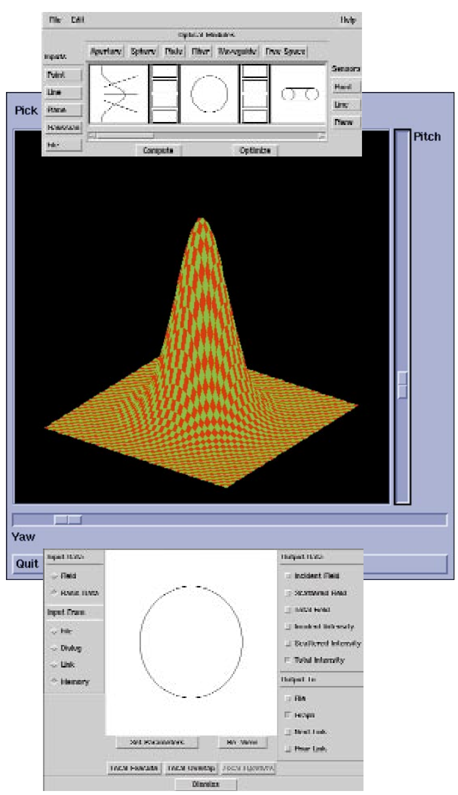
Talented people

Creativity and talent are attributes that we nurture and recognize. Since 1987, Engineering personnel have received over 30 R&D 100 awards. The winning entries of this international competition are judged the 100 most technologically significant new products and processes of the year. Recent Engineering winners include:

- A miniature low-cost optical amplifier, which amplifies optical signals at ultra-high (terabit per second) rates.



- MELD, a computer-aided-drafting tool for low-cost manufacturing of optoelectronics.



- The Oil Field Tiltmeter, which images hydrofractures at least 10,000 feet below the surface of a well.

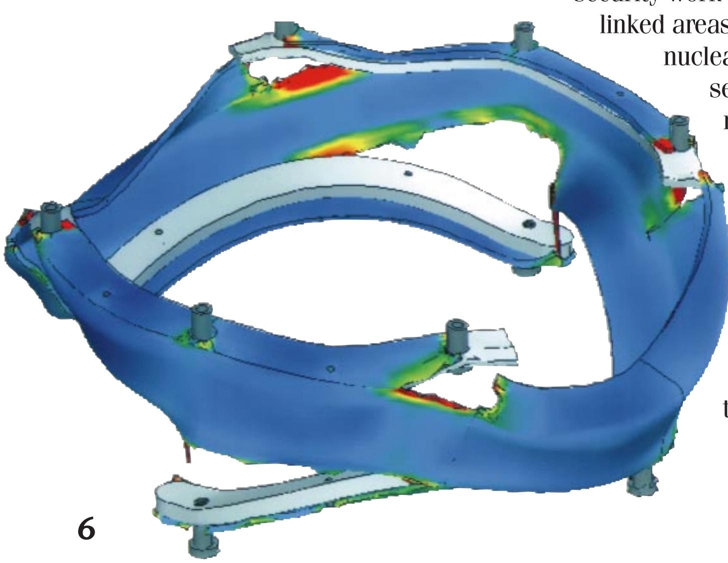
State-of-the-art facilities

Engineering provides world-class engineering resources, including facilities with unique capabilities. We have over $500 million invested in facilities and equipment that our engineers use to tackle on-the-job challenges. We own and operate about 35 facilities at the main site, including the Microtechnology Center—which contains comprehensive microfabrication and device processing labs for developing novel microsystems—and the Nondestructive Evaluation Facility—which has capabilities in computed tomography, three-dimensional (3-D) infrared and emissivity imaging, digital and real-time radiography, acoustic microscopy, and more.

This figure demonstrates the electromagnetic waves propagating from the right and coupling to the airframe of an RAH-66 Comanche helicopter. This work will feed into the design developments of the Comanche using more sophisticated models as the project unfolds. This image shows one thin slice from the complete 3-D model.

Open-air hydrodynamic test at the Flash X-Ray (FXR) facility at Site 300. FXR is a linear induction accelerator used for flash radiography. FXR provides LLNL scientists with test data for verifying computer-simulated predictions of how imploding objects behave.

Applying the Laboratory-developed finite element code DYNA3D, engineers used computer-based analysis to design a shock-absorbing flange for a weapons component transport container.



JOIN ENGINEERING—WE MAKE LABORATORY PROGRAMS SUCCEED

Engineering is committed to helping the Laboratory's programs meet their objectives on time, within budget, and to specification. Our new Engineering and Science Technology Program "grows" new core technologies for the entire Laboratory to use for the next five years.

Engineering is the largest technical organization at the Laboratory, with approximately 2100 employees belonging to electronics, mechanical and other engineering disciplines. Nearly 80% of our engineers have advanced degrees in a variety of technical areas. Electronic and mechanical engineers are part of multidisciplinary research teams that may include physicists, computer scientists, mathematicians, chemists, and geologists. On some projects, engineers collaborate with university or industrial partners, or staff from other national laboratories. There are also opportunities for independent research.

Laboratory programs: Solving problems of national importance

Engineers, physicists and other Lawrence Livermore technical staff do experiments and other research to understand basic scientific principles and to develop the technology needed to enhance national security. This national security work focuses on two closely linked areas: ensuring that the U.S. nuclear stockpile remains safe, secure, and reliable, and nonproliferation and arms control. The Laboratory addresses other topics of national importance as well, such as laser research, biotechnology, and environmental sciences. In all these areas, engineers are key to the Lab's R&D efforts.

Stockpile stewardship and management

"Stockpile stewardship and management" refers to the national programs for keeping the country's nuclear weapons safe, secure, and reliable without nuclear testing.

As an engineer supporting the stockpile stewardship and management effort, you would be part of LLNL's national security work. You could be supporting physics design studies of high-explosive-systems behavior. In this role, you might design, manufacture, assemble, and characterize precision experiments that employ high explosives for instrumented test firings. Or, you could be supporting studies of fundamental laser-material interactions. You might also assist in the precision design, manufacture, and assembly of unique target configurations for high-energy laser experiments.

In stockpile management, you could be involved in the surveillance, refurbishment, and dismantlement of LLNL stockpile nuclear weapons, along with other related activities. You could be developing structural and thermal computer models to study weapon behavior under transportation, handling, and storage conditions. Or you might be supporting component design, manufacturing and testing.

Engineers supporting the stockpile stewardship and management efforts also engage in leading-edge activities such as system performance, and phenomenological and environmental testing. They also develop new initiatives that extend state-of-the-art defense technology to related biomedical, industrial, and commercial applications.

Two key elements of the Laboratory's stockpile stewardship effort are the National Ignition Facility (NIF) and the Accelerated Strategic Computing Initiative (ASCI).

National Ignition Facility

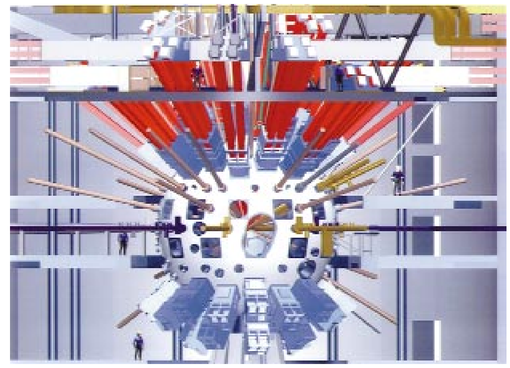
NIF will be an experimental laboratory facility containing the world's most powerful laser. NIF's 192 laser beams will focus simultaneously onto a tiny target capsule containing fusion fuel. The goal is to create—in the laboratory—the same fusion forces that drive both nuclear weapons and the sun. NIF will provide essential data about weapons safety and reliability. It will also take the country a giant step closer to the 21st century goal of power production through fusion energy.

As an engineer supporting NIF, you could be developing software for a state-of-the-art, 35,000-point control system in a distributed, object-oriented environment. Or you might be involved in optics processing, cleaning, and handling in an environment where conditions are extreme and cleanliness is crucial. For NIF, more than 7000 large components must be acquired, inspected, installed, and maintained. Engineers supporting NIF develop and implement diagnostic systems. These systems observe target events on scales of microns and picoseconds in the visible to x-ray spectral region. Engineers also design laser fusion targets—a few millimeters large—containing highly precise details and using unusual materials. Many of these targets must also operate at cryogenic temperatures. You may be developing materials and instruments that can survive a nearby fusion explosion.

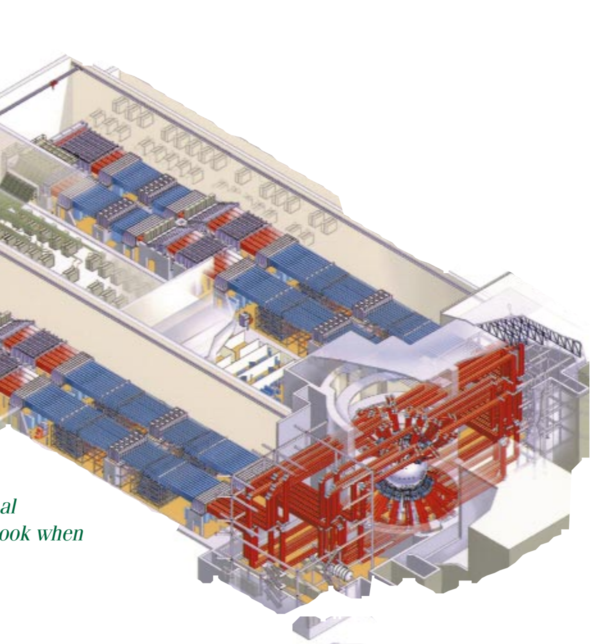
Engineers develop laser diagnostics and targeting equipment of unprecedented precision. They also design equipment that can install several-hundred-pound mechanical packages to a precision of tens of microns in superclean environments. Finally, there are many operations engineering opportunities in this large, high-tech experimental facility.

Accelerated Strategic Computing Initiative

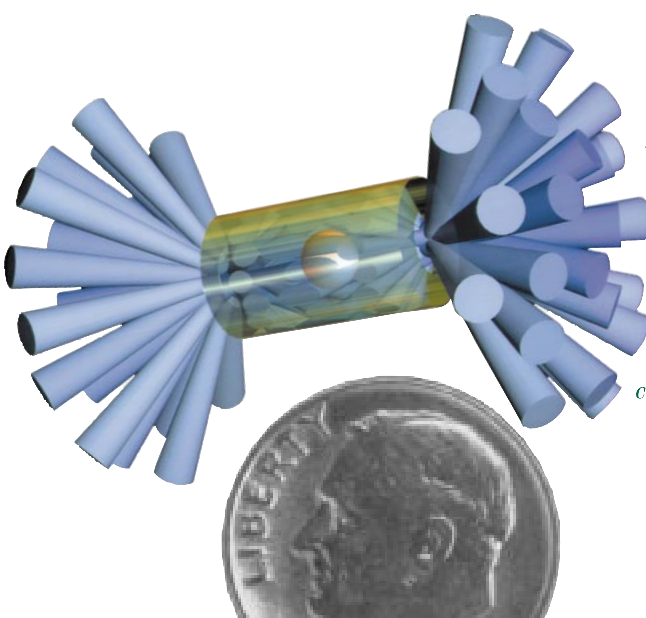
The ASCI project is developing the computing capabilities needed to run the 3-D simulations that must, to the extent possible, replace nuclear testing. To do this requires supercomputers a thousand times faster and more powerful than what exists today. Mechanical engineers support ASCI by adding advanced physical and numerical models into 3-D Arbitrary Lagrangian/Eulerian hydrodynamics computer codes and by testing codes on weapons engineering problems. Electronics engineers are helping to implement the advanced networking requirements for a tera-scale computing infrastructure.



In the "indirect-drive" beam configuration, up to 192 laser beams enter the NIF target chamber from top and bottom for compressing the fusion target, leaving the middle free for diagnostic equipment.



This rendering shows the overall National Ignition Facility (NIF) system as it will look when operation begins in 2003.



The NIF indirect-drive (a "hohlraum") target is a hollow metal case the size of a dime surrounding a spherical, BB-size capsule containing fusion fuel. When laser beams enter the open ends and strike the inside wall of the hohlraum, laser energy heats the inside of the hohlraum, creating x rays that completely surround the target.

Dave Pehrson

In 1965, Dave Pehrson was scanning the *New York Times* when he found a small ad from Lawrence Livermore for electrical engineers with computer engineering backgrounds. Dave had just completed his M.S.E.E. from New York University while at Bell Labs and was considering returning to the West Coast. "My B.S. was from University of California, Berkeley, with an emphasis on computer engineering," said Dave. "I responded to the ad and came out for an interview."

The mid '60s were the beginning of "high end" computing. MIT had created the first time-sharing computer, with three teletype terminals. Lawrence Livermore was working with Control Data Corporation (CDC) on their 6600 supercomputer and needed engineers to help develop an advanced time-sharing system. It was a challenge Dave couldn't resist. He joined engineers and computer scientists who built a networking system to bring the CDC 6600 to the desktops of Laboratory researchers.

Dave then became an Engineering group leader, taking his first step up the management ladder. A couple of years later, he became a division leader in the Lab's computer science organization. His division created operating and language systems for machines that were the backbone of the Laboratory's computing efforts. In the mid '70s, Dave returned to Electronics Engineering to lead the Magnetic Fusion Energy Division. His division helped build a series of huge tandem-mirror fusion machines and several large beam accelerators for directed energy applications. Specifically, his team fielded the technology for high-power ion beam and microwave systems to heat the fusion plasmas. In the mid '80s, he took an equivalent role supporting the Laboratory's laser programs. Nova—the precursor to the National Ignition Facility—was being designed and constructed. In addition, the Laboratory's atomic vapor laser isotope separation (AVLIS) technology was entering a "go for broke" national competition, called DEMO 85, against the competing centrifuge technology. "In retrospect, DEMO 85 was one of the highlights of my career," noted Dave. "For 18 months, people from all over the Laboratory committed themselves to winning this competition. The DEMO 85 team worked with intense camaraderie under extreme pressure—we gave it our best, and, in the end, we prevailed."

In 1988, Dave moved up to head Electronics Engineering within Engineering, seizing the chance to share his experiences with others. In 1992, he took a two-year stint as acting Human Resources manager for the Laboratory. When a permanent manager was selected, Dave returned as deputy associate director for Engineering.

In reviewing his 30-plus years at the Lab, Dave said, "It's been incredibly fun! I've worked on projects with national and international impact. I was part of pioneering work and have been privileged to work alongside many world-class experts.

"When I used to interview on campus, I encouraged students to look at what organizations offer 'for the long haul.' With its multidisciplinary programs, nonhierarchical environment, and strong ties to the University of California, I believe the Lab offers a unique setting for engineers to stretch and mature in their professions."

Karla Hagans Profile

When Karla Hagans finished her M.S.E.E. from Georgia Institute of Technology in 1984, she wanted to work with integrated optics, a field still in its infancy. “I discovered that all that cool stuff you learn about in school, all those cutting-edge technologies, aren’t really much in evidence in the work world. In ’84, not too many places were dealing with integrated optics, but the Lab was.”

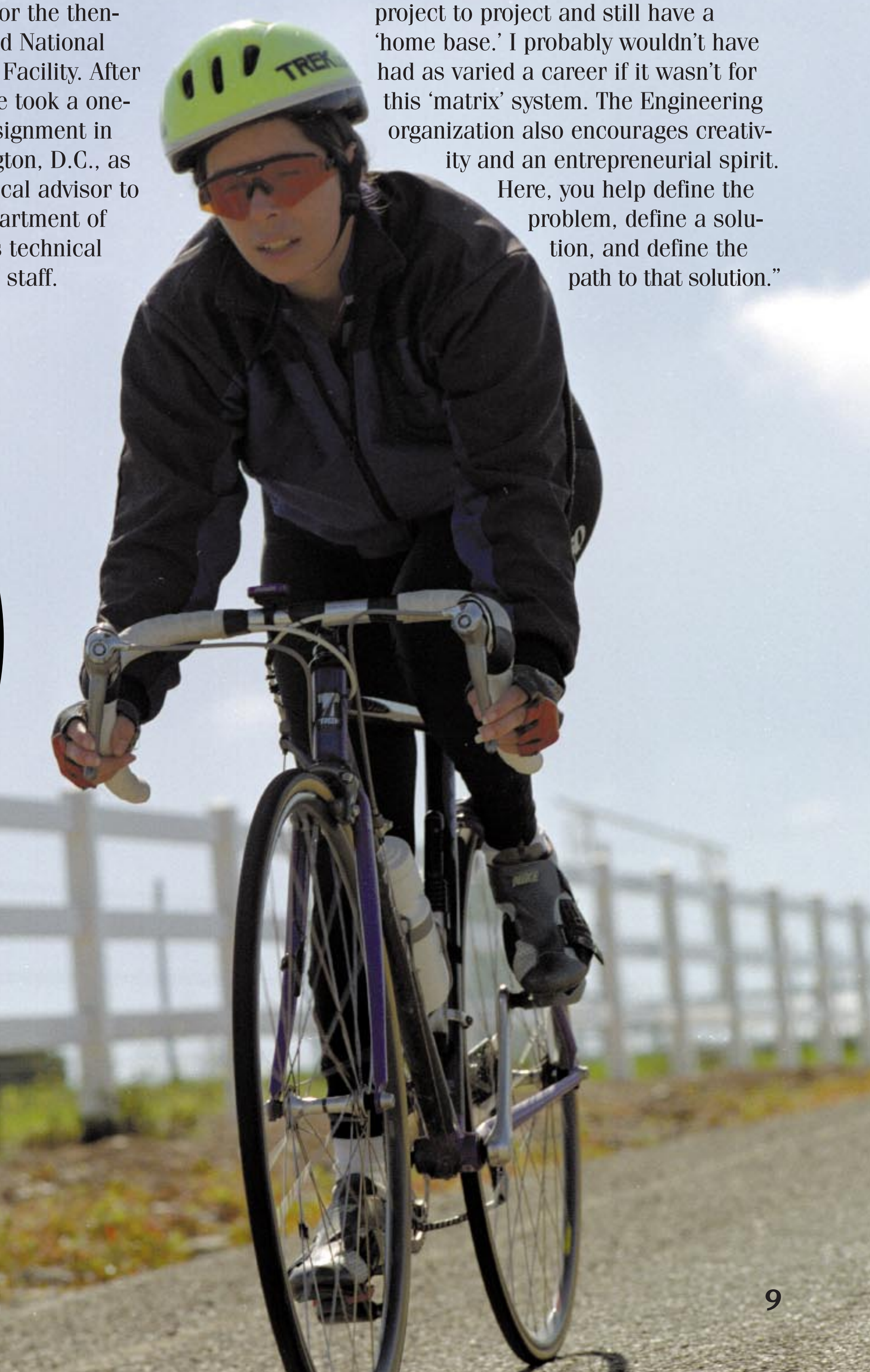
That sold her on the Lab. “That, plus the work looked incredibly challenging, and I liked the rural feel of Livermore and the idea of a five-minute commute,” she added.

Karla worked in Lawrence Livermore’s underground testing program in the mid-’80s before moving on to the uranium atomic vapor laser isotope separation (U-AVLIS) program in 1990.

“One of the fun things about these big projects is that we developed, tested, and deployed the systems we worked on,” she said. For the test program, she developed a fiber-optics-based system for diagnosing the physics of nuclear tests. In U-AVLIS, she led a group developing a laser-based diagnostic system. “We developed a simplified version for plant operation, which received a patent,” said Karla. Next, she worked on the conceptual design review for the then-proposed National Ignition Facility. After that, she took a one-year assignment in Washington, D.C., as a technical advisor to the Department of Energy’s technical transfer staff.

Karla returned after her D.C. assignment to head up a group responsible for creating fiber-optics safety systems for nuclear weapons in the stockpile.

“The variety of work here is tremendous,” she noted. “The Lab is one of the only places I know where an engineer can work on really big multidisciplinary projects of national importance. Another thing I like is that, in Engineering, you can move easily from project to project and still have a ‘home base.’ I probably wouldn’t have had as varied a career if it wasn’t for this ‘matrix’ system. The Engineering organization also encourages creativity and an entrepreneurial spirit. Here, you help define the problem, define a solution, and define the path to that solution.”



PCRman—the world's only portable, battery-operated DNA analysis system—was designed and built by LLNL engineers. This instrument performs real-time detection of pathogenic organisms.

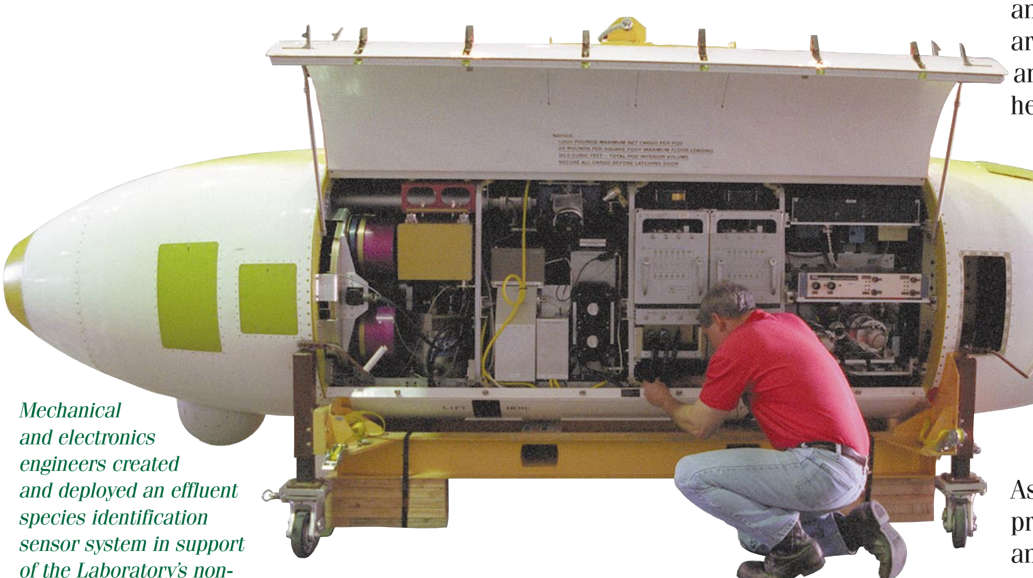
Nonproliferation and arms control

In the nonproliferation and arms control area, Laboratory personnel invent instruments and techniques for monitoring compliance with arms-control agreements. LLNL staff also provide technical advice to the federal government and to U.S. treaty negotiating teams on what can be detected, measured, and verified.

Engineers play an important part in the Lab's nonproliferation and arms control efforts. They participate in the dialogue with the government and agency representatives. They also provide both leadership and technical staffing for government-funded projects. As an engineer, you would be inventing, modeling, building, and operating the sensors, devices, instruments, and systems needed to achieve project goals. In some cases, engineering inventions lead to new projects.

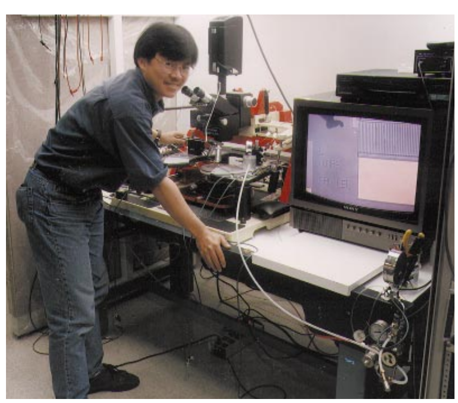
Laser research

Laboratory researchers are pursuing the inertial confinement fusion (ICF) approach to fusion energy through the National Ignition Facility discussed earlier in this brochure. The Laboratory is also pioneering the use of laser-based microtechnologies. Such microtechnologies include extreme ultraviolet lithography for integrated circuit manufacturing. The Lab also researches the use of radar in industry and defense. Scientists and engineers are exploring the uses of laser, x-ray, and ICF technologies in areas such as healthcare, microelectronics fabrication, and vision enhancement. Researchers are also developing technologies for the processing, manufacture, storage, and disposal of strategic nuclear materials, principally uranium and plutonium.



Mechanical and electronics engineers created and deployed an effluent species identification sensor system in support of the Laboratory's nonproliferation efforts. The system includes optical remote sensing instruments and atmospheric samplers.

As an engineer, you might use your precision engineering skills to design and engineer hardware that resolves surface features and surface finishes in the tenths of nanometer regime. Or, you might engineer the advanced optics and lens coatings required to develop these laser technologies. You may support advanced thermal and structural modeling, using finite element analysis techniques to ensure that outside influences do not compromise system integrity. As an automatic control engineer, you might develop feedback control loops incorporating "learning" to provide real-time system corrections as the physical hardware degrades. These are just a few of the many avenues open to you as an engineer supporting laser research at Lawrence Livermore.



Using a microscope/monitor, engineer Abe Lee inspects the micromirror he developed in support of the Laboratory's extreme ultraviolet lithography research.

Biotechnology

In biotechnology, through human genome work, the Laboratory's bioscientists are decoding DNA and investigating the detailed processes involved in DNA replication and DNA damage. Scientists and engineers are also developing novel healthcare technologies, such as microsurgical tools and medical lasers.

Engineers are key to the Laboratory's bio-instrumentation effort, including automation/robotics, flow cytometry, nucleic-acid analysis, image capture, and image analysis. Other efforts include high-density hybridizations of nucleic acid samples, electrophoresis, and instrumentation for structural biology. If you were to work in this area, you might be designing modifications to existing systems or inventing new systems.

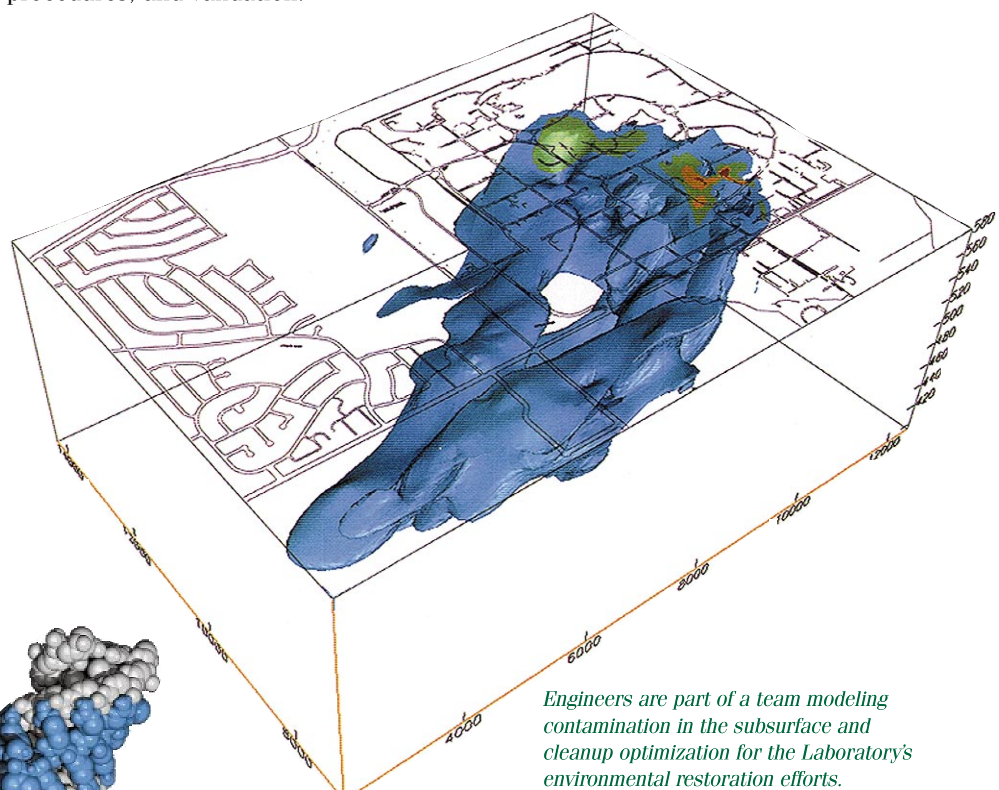
Scientists are working to identify and understand the function of genes responsible for DNA repair. This graphic shows the steps in one DNA repair pathway called excision repair.

Environmental sciences

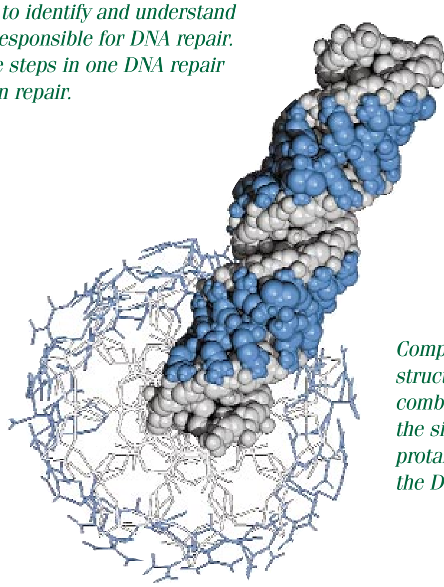
At the Laboratory, researchers are trying to understand the complex, interrelated processes that govern global climate. They also are exploring the effects of human activities on the environment. Other scientists and engineers are developing technologies for preventing pollution and for cleaning up contaminated soil and water.

Within Engineering, we have developed instrumentation for detecting hazardous chemical and biological materials in the field. As an engineer supporting the environmental area, you would work with scientists and sponsors, exploring activities to help provide for incident response, decontamination procedures, and validation.

Dynamic underground stripping, an environmental remediation technique, was used to remove gasoline from soil and groundwater at LLNL. Insert: Electrical resistance tomography (ERT), developed by Laboratory engineers, helped researchers monitor steam injection during the dynamic stripping process. ERT produces pictures of electrical resistivity, analogous to CAT scans or MRI images.



Engineers are part of a team modeling contamination in the subsurface and cleanup optimization for the Laboratory's environmental restoration efforts.



Computer modeling is an integral part of LLNL's structural biology research. This graphic combines two views (space filling viewed from the side and stick model viewed end on) of the protamine molecule (blue) as it interacts with the DNA molecule (white).

Donn McMahon

Donn McMahon came to the Laboratory in 1995, choosing it over many other options. "The Lab offered the perfect middle ground between the pure research environment of academia and project-oriented industry," Donn said of his decision.

Donn did his undergraduate work at MIT and his graduate work at UC Berkeley, earning a Ph.D. in mechanical engineering, with a specialty in control systems, in 1994.

Before joining NIF a little over two years ago, Donn worked on engine modeling for hybrid vehicle development and in accelerator technology in support of the Stanford Linear Accelerator Center. These first assignments helped him get oriented and develop breadth, he said, but it's his current work in the Operations Engineering Group of NIF that Donn sees as the best use of his skills in control systems. As part of the Operations Engineering controls group, he designs controls systems for assembly, transport, installation, maintenance, and refurbishing of NIF optics.

Donn's primary roles with NIF are twofold. His first task involves the development of a control system for a LLNL-developed optic delivery system used in the "side-loading" of the NIF optics, that can be used in an autonomous or semi-autonomous mode. "It's an interesting and challenging job," Donn said, "working with optics weighing as much as 2000 pounds, under clean-room conditions, and dealing with vibration, shock, and precision alignment issues.

In his other role, he is responsible for the specification and interface of the control and electrical systems of a 30,000-lb automated vehicle system with NIF Operations optic delivery. Integration of all the various Lab and vendor components is a fairly involved process. "Careful attention must be paid to hardware selection, software design, and consistency with the controls system architecture."

Donn appreciates the way the Lab encourages "leading out"—building extensions of Laboratory technology to different areas, and to academic and industrial partners. "This type of atmosphere enables you to gain experience on a variety of different projects all under one roof."

Louis Bertolini

Profile

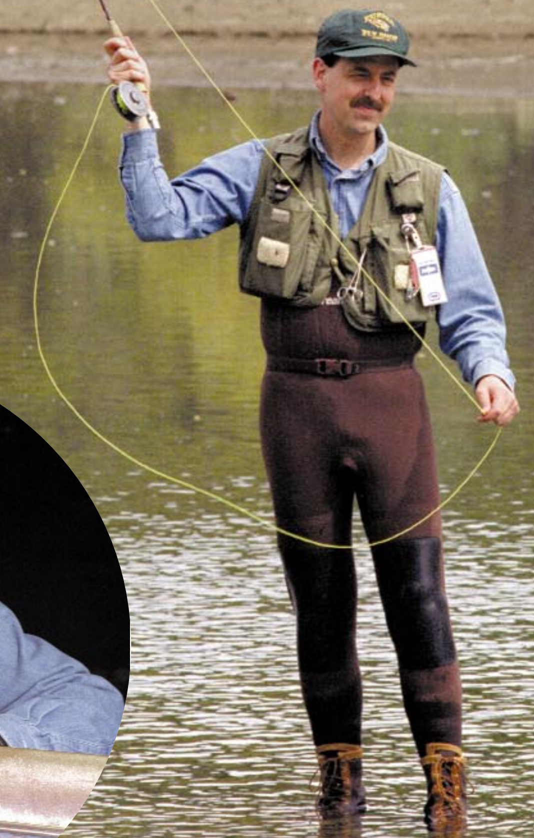
When Lou Bertolini graduated with a B.S. in engineering from California Polytechnic Institute, San Luis Obispo, it was 1978. When he evaluated his two job offers—one from a large petroleum company on the East Coast and the other from Lawrence Livermore—it wasn't a hard decision. "For me, the Lab had by far the more interesting job," he said, "one that involved challenging technical work."

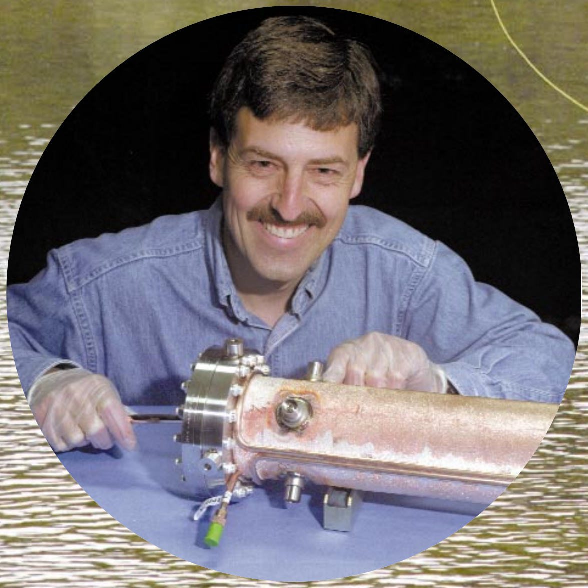
For the next ten years, Lou developed a variety of mechanical systems for programs throughout the Laboratory. For instance, he helped to design separator hardware to demonstrate the feasibility of separating uranium and plutonium isotopes using very-high-power lasers. In 1990, he worked on the Super-High Altitude Research Project, the world's largest giant gas gun. "For most of that project, I was the only mechanical engineer," Lou said. "And I had to do whatever it took to get the system up and going." Next, he worked on a team developing a new rocket propulsion concept. "The flight test for the propulsion system at Vandenberg Air Force Base required the rocket to accelerate on a guide rail until it was traveling fast enough to fly stably. We needed to test this rail system first. So, we designed and built the guide rail and the launch tower, and worked with a model rocket club to develop a full-scale model rocket for our rail test at the Lab's Site 300. I'm proud to say, we launched the one and only rocket in Site 300's history!"

In '94, Lou joined the Livermore engineering team designing a system—the "B Factory"— to look for B mesons at the Stanford Linear Accelerator Center (SLAC). As part of that project, he developed an ultra-high vacuum pump (10^{-9} to 10^{-10} torr) used by SLAC's high-energy physicists. "There are no large particle accelerators here at LLNL," explained Lou. "But we regularly build experimental systems used on some of the world's largest particle accelerators, such as those at Brookhaven National Laboratory and SLAC." Lou now heads up that engineering group. In addition to his managerial responsibilities, he maintains a technical role. "I need to continue technical work at some level," he said. "First, I love the work itself, and second, I find it's invaluable to me as a manager. For instance, I put some QC processes into place. Since I'm still engineering mechanical hardware, I found out first-hand how painful some of those practices were. I was then able to make some mid-course corrections."

About Engineering at the Laboratory, Lou notes, "When I look back over my years at the Lab, I've had five to six mini-careers. I've supported many different programs, yet remained an Engineering employee the entire time. Those sorts of opportunities are hard to find elsewhere."

Another thing Lou likes about the Lab is that he works on projects from design through fabrication and testing. "In many places outside the Lab, MEs design things, but never get to see the actual system they design! I'll tell you, I've never made a mistake on paper. It's only by following a system through its assembly, test, and operation that the flaws become apparent. It's only by being involved in the whole process that I learn lessons I can apply to the next job."





CONTINUE YOUR EDUCATION

The Engineering organization and the Laboratory as an institution are committed to keeping employees up-to-date in their fields. Because engineering technologies change rapidly, we promote professional development in many ways.

First, within Engineering there is ample opportunity to change assignments periodically, in order to broaden your work experience and promote career growth.

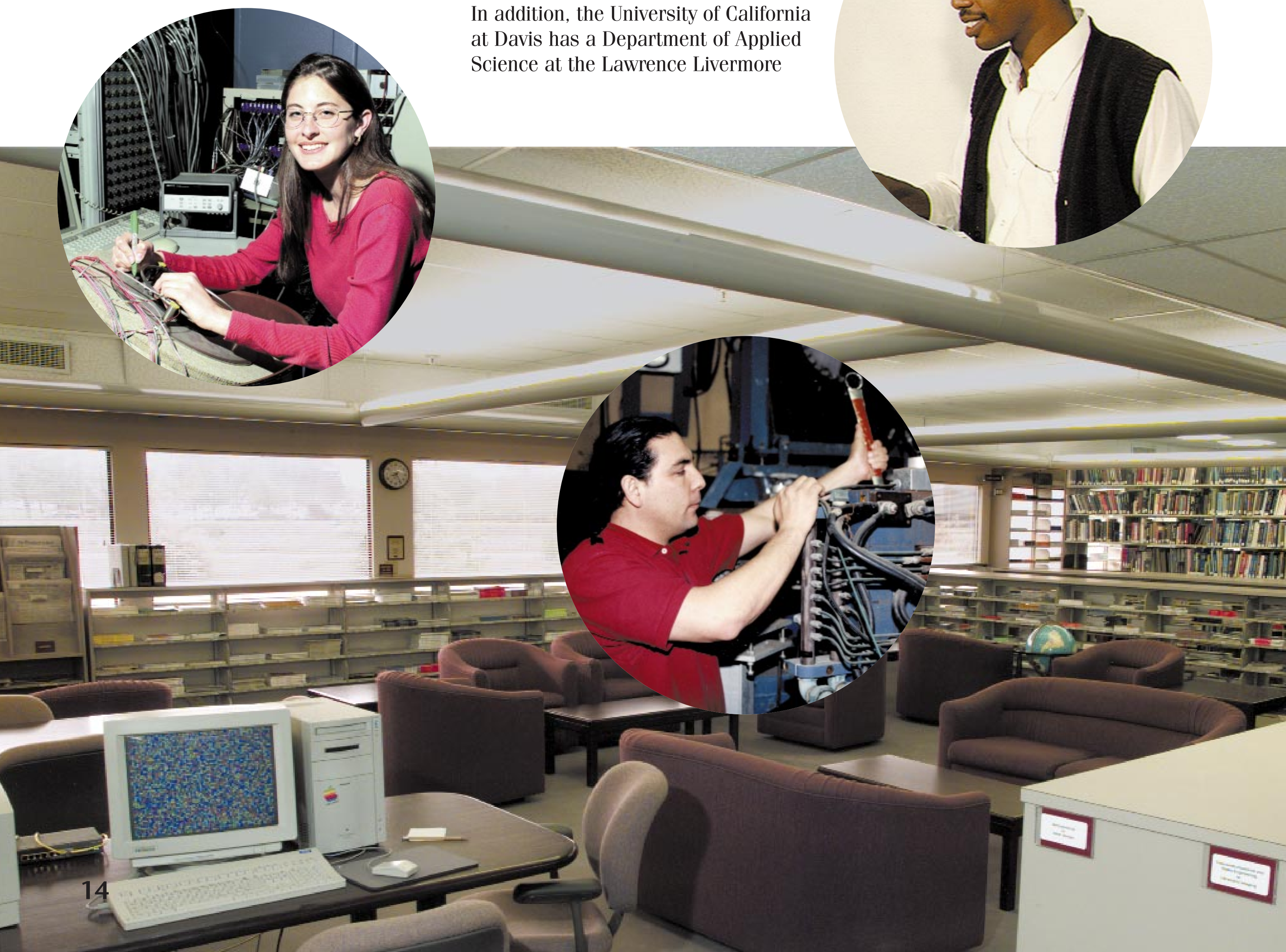
You can also explore new areas of engineering through the Laboratory's continuing education program. Each year, hundreds of technical short courses, including seminars and lectures, are sponsored on site to provide leading-edge information. LLNL also offers quarterly classes on nontechnical subjects, such as management and communication. In Engineering, we offer diversity training to all Engineering employees so that they develop an understanding of the business necessity for diversity.

Employees are encouraged to pursue continuing education opportunities. There are associated programs at over 30 Bay Area colleges and universities. Closed-circuit television links LLNL with the University of California campuses at Davis and Berkeley, and with Stanford University; a satellite connects the Laboratory with the National Technological University.

In addition, the University of California at Davis has a Department of Applied Science at the Lawrence Livermore site. The department grants graduate degrees in engineering/applied science and computer science.

We encourage employees to attend outside conferences, seminars, and short courses, and to visit other research institutions to help keep abreast of current advances.

From the start, your future here is up to you. You'll find that your performance, interests, and continuing education will determine your career path as a Lawrence Livermore engineer.



RECEIVE A COMPETITIVE SALARY AND FIRST-CLASS BENEFITS

Our salaries are competitive with private industry. As a University of California employee working at the Laboratory, you immediately receive a full range of benefits. There are 12 paid holidays a year. Full-time employees earn three weeks of vacation a year, increasing after 10 years of service. The Laboratory also offers a wide range of insurance programs—including health, vision and dental—and retirement plans, including a tax-deferred 403(b) savings plan and a defined benefits pension plan.

The Employee Services Association

Another benefit is automatic membership in the Livermore Laboratory's Employee Services Association (LLESA).

Laboratory employees and their families are encouraged to pursue their exercise, cultural, educational, community service, and social interests through LLESA's activity groups. More than 50 activity groups are sponsored by the association, including Amigos Unidos, Organic Gardening, Chess, Frisbee, and bicycling. LLESA also manages an Olympic-size swimming pool on site, which offers swimming lessons all summer to employees and their families. Noontime lap swimming is available year-round to employees. Running, walking, aerobics, and rollerblading are also popular noontime activities.

In addition, the association manages an on-site employee store and a parent-supported childcare center just a few minutes' drive from the Laboratory's main site. The center accepts children from six weeks old through the fifth grade.

The Laboratory's Employee Services Association provides a number of services for employees and their families, including cultural activities, exercise classes, and a nearby childcare facility. The association also manages an Olympic-size swimming pool on site, which supports activities such as Masters' swimming and underwater hockey.

Jose E. Hernandez

When Jose E. Hernandez interviewed at the Laboratory in 1985, he was immediately drawn to the rural feel of the Livermore area and the surrounding hills. "I also interviewed at companies in the Silicon Valley and Los Angeles," he noted, "but the Lab's location, and the challenging work it offered in signal processing, really attracted me."

Jose received a B.S.E.E. from the University of Puerto Rico and an M.S.E.E. from Georgia Institute of Technology. He worked two years for a commercial research and development laboratory on the East Coast before coming to Lawrence Livermore.

At the start of his Lab career, Jose worked on SIG (a general-purpose signal-processing package developed by LLNL), adding enhancements to support several array signal processing projects. From there, his interests led to image processing, "I basically learned as I went," he said. "I took some University of California, Davis, courses here on site. I ended up spending about two years developing a library of image processing and pattern recognition algorithms." He also created VISION, a LISP-based object-oriented environment for developing image processing and pattern recognition programs. His next challenge was to develop real-time image processing systems, which he has been doing ever since.

As an electronics engineer at the Laboratory, Jose has also been a principal investigator (PI) on three projects. The first, called Lifeguard, was a real-time image processing system for tracking bullets in flight. Next, in a cooperative agreement with the textile industry, Jose and PIs from six other national laboratories joined together to develop a system for finding defects in fabrics. CAFE, the resulting computer-aided fabric evaluation system, garnered interest from the *New York Times*, CNN, and ABC. He's now working with the paper industry to develop a system that will monitor several properties of the paper "web" on-line during the manufacturing process.

"One of the great things about the Lab," Jose said, "is that you can move around, work in different projects with different people, and still stay within Engineering. In my years here, I've worked on projects for the old Test Program—before the Cold War ended—to industrial collaborations. In a way, it's up to me what I'll be doing next year. The work is the number one reason I came here. There's lots of flexibility, and lots of ways to go as an engineer."

Abraham Lee had just earned his Ph.D. in mechanical engineering from University of California, Berkeley, when he interviewed at the Lab. At UC, he had been working in the Berkeley Sensor and Actuator Center on microelectromechanical systems (MEMs). "I had some other job offers," he said. "But one thing that sold me on the Lab was when I visited Engineering's Microtechnology Center. It was a true interdisciplinary center with electrical engineers, chemical engineers, biologists, and material scientists. It also had a new clean room, so I could get to work right away. Most important of all was that I would be applying my engineering skills to healthcare. That appealed to me very much. All in all, it looked like a good opportunity. At that time, the Laboratory was just beginning to become a world-leader in the MEM field. That was also very attractive."

Abe first joined the Laboratory as a post-doctoral research staff member on a term appointment. At the Laboratory, he focused his expertise on developing microtools for medical use. One of his first projects was developing a microgripper (background photo this page) that could fit in a catheter and carry embolic material to an aneurysm in the brain. He worked with doctors, a world-renowned medical center, and other LLNL researchers.

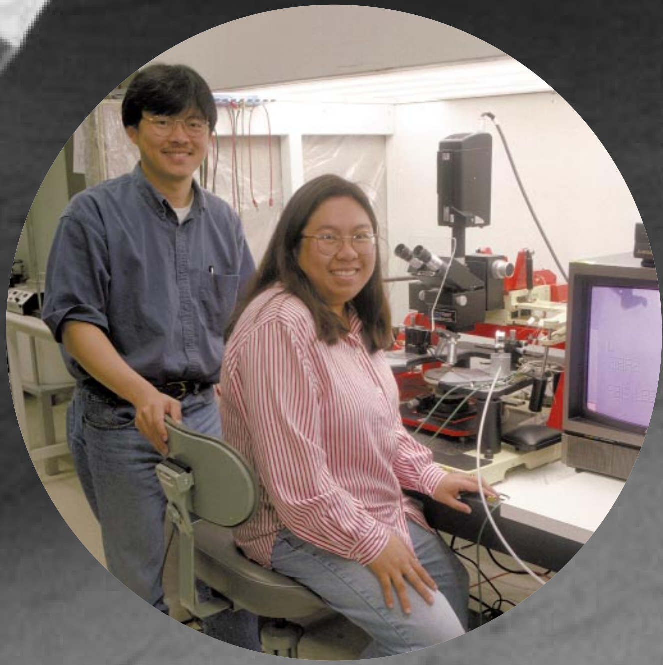
He has a concept for a similar tool, which is the basis for a recently formed partnership between the Laboratory and a medical company. "We're aggressively pursuing this idea," said Abe. "I expect I'll be involved in lots of different aspects: patent issues, business schedules and deadlines, market issues, and so on. This promises to be very challenging, and I'm looking forward to it! I like to do new things, and this will be a new experience for me."

He has also been developing different types of microactuators—for example, electrostatic, smart polymer, and heat-driven. He has published papers about them and given presentations at conferences . . . all with Engineering's support.

"I like the people at the Laboratory and Engineering's matrix system," noted Abe. "I work with researchers who are leaders in their fields and with industrial collaborators. In addition, I am an advisor for a graduate student (see photo below) from the University of California, Davis, Applied Sciences Department, which is right here on site."

With the matrix system, Abe can work on different projects and still stay in Engineering. He applies his specialty to biology, lasers, chemistry, and other areas. For instance, he is now working with LLNL laser researchers, applying microactuators he has designed to an optical mirror system that will be used for extreme UV lithography.

"Right now, I'm having a lot of fun," said Abe. "Since this is a national R&D laboratory, it provides a place where you can make a difference, more so than most places. That's also important to me."



EXPLORE THE AREA

The Livermore Valley offers a rural/suburban environment with easy access to cities, beaches, and mountains. The Valley is home to several world-famous wineries, a community symphony and opera company, and eight golf courses.

The Valley also has a full range of recreational activities just a few minutes away from the Laboratory. Windsurfers skim the waters at Del Valle or Shadow Cliffs regional parks. Del Valle and nearby Sunol regional parks provide trails for the casual stroller and serious hiker, as well as overnight camping opportunities. Cyclists can find scenic flat country lanes as well as steep, challenging climbs in the nearby hills.

One hour to the west is San Francisco, with the metropolitan centers of San Jose and Oakland closer still. Berkeley with the University of California and Palo Alto with Stanford University are only 50-minute commutes from Livermore. These cities are close enough to make an evening at the theatre, ballet, or symphony an easy drive. Museums and galleries beckon from San Francisco and other Bay Area cities. BART (Bay Area Rapid Transit) provides easy public transportation via rail and bus to cities such as San Francisco, Berkeley, and Oakland.

West of San Francisco is the Pacific Ocean. The scenic Pacific Coast from Monterey and Big Sur in the south to the Mendocino Coast in the north are all within about a three-hour drive. If you head east, the Sierra Nevada (with Yosemite and Lake Tahoe) are also about three hours away, offering unparalleled camping, hiking, skiing, and climbing.

From cities to the seashore, northern California is yours to explore.

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